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RESEARCH ARTICLE

The effect of stress level on the therapeutic outcomes of type 2 diabetes mellitus at the regional public hospital of West Nusa Tenggara province

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Abstract

Introduction: Diabetes Mellitus (DM) is a complex chronic disease that requires ongoing medical care with a multifactorial risk reduction strategy beyond glycemic control. Self-management, education, and support are essential to prevent acute complications and reduce the risk of long-term complications. Stress levels may affect fasting blood glucose (FBG) and 2-hours postprandial blood glucose (2HPPBG). **Aim:** This study aims to determine the effect of stress levels on the therapeutic outcomes of type 2 DM patients at the regional public hospital of West Nusa Tenggara province. **Methods:** This observational, cross-sectional research was carried out on a sample of 37 patients using the Perceived Stress Scale (PSS). Data analysis used a linear regression test. **Results:** The results showed that stress had a significant effect on FBG (p=0.038) and 2HPPBG (p=0.001) levels.

Introduction

Diabetes Mellitus (DM) is a disease in which blood glucose (simple sugar) levels are high because the body cannot release or use insulin sufficiently. Self-management, education, and support are essential to prevent acute complications and reduce the risk of long-term complications. A significant body of evidence supports various interventions to improve DM therapy outcomes (American Diabetes Association, 2020). According to Riset Kesehatan Data (Data Health Research), the prevalence of non-communicable diseases in 2018 has increased compared to previous years (Data Health Research, 2018). The prevalence consensus of the Indonesian Endocrinology Association reported that, in Indonesia, DM prevalence based on doctors' diagnoses in patients below 15 years has increased from 0.15% in 2013 to 0.2% in 2018 (Perkeni, 2015). In people above 15 years, and according to blood tests, it also increased between 2013 and 2018 (Data Health Research, 2018).

The psychological impact of DM, including treatment-related stress, is experienced by patients since the early stages of the disease and may last for years, given the chronic nature of the illness (Avci & Kelleci, 2016). Stress seems to highly influence diabetes because it affects the control and level of blood glucose levels (Glover *et al.*, 2016). During a stressful situation, the body response can be in the form of increased adrenaline, which eventually converts glycogen

reserves in the liver into glucose. Over time, high blood glucose levels may lead to complications of diabetes.

Stress and DM have a very close relationship, especially in urban residents. Life pressures and unhealthy lifestyles accompanied by rapid technological advances and various concomitant illnesses can cause a person's condition to deteriorate. DM patients who experience stress may have problems in controlling blood glucose (Golden *et al*., 2008; Knol *et al*., 2006; Richard *et al*., 2002). Stress levels in DM patients were measured using the Perceived Stress Scale (PSS), a 10-item questionnaire that identifies the respondent's stress description. This instrument was validated by Zaenal Arifin in 2011, with a validity and reliability value of 0.85 (Arifin, 2011). The measurement of diabetes stress plays an essential role in improving the quality of health and well-being of patients, especially at the regional public hospital of West Nusa Tenggara province, where the number of outpatients in 2018 reached 2.249 per year.

The objective of this study is to determine the effect of stress on fasting blood glucose levels (FBG) and 2 hours after meals (2hPPG) in outpatients with type 2 diabetes mellitus at the regional public hospital of West Nusa Tenggara province.

Methods

This study used an analytical observational method with a cross-sectional approach in determining the effect of stress on fasting blood glucose levels (FBG) and 2-hours after meals (2hPPG) in patients with type 2 diabetes mellitus (T2DM) at the Internal Medicine Department of the regional public hospital of West Nusa Tenggara province. It was performed from February 2020 to May 2020. The inclusion criteria were T2DM patients aged ≥46 years who had been taking oral antidiabetics for at least six months (with ICD code X E.11) before the stress measurements and were willing to sign the informed consent form. The exclusion criteria were deaf, illiterate, and pregnant patients. The final sample included 37 T2DM patients who met the inclusion criteria. This study had been approved by the ethics committee of the regional public hospital of West Nusa Tenggara province, Indonesia, number 070.2/13/KEP/2020.

The Perceived of Stress Scale (PSS) is a valid 10-item tool, covering both anxiety and depression, used to measure the response of individuals to stressful situations by direct observational interviews with patients (Arifin, 2011); validity and reliability test results were 0.85, similar to Arifin results (Arifin, 2011). It is an efficient scale to measure the relationship between stress appraisal and the risk for any disease (Vasanth *et al*., 2017; Al Kalaldeh & Abu Shosha; 2012). Data were collected through interviews and medical records or patients, which include name, age, gender, diagnosis, treatment, and laboratory data.

The data were analysed descriptively on SPSS 20.0 using patients' characteristics. Linear regression was performed to measure the effect of stress levels on FBG and 2hPPG.

Results

Subject characteristic

The characteristics of T2DM patients taken during the study included gender, patient age, and length of time the patient suffered from DM.

The effect of stress on blood glucose levels

Stress levels are associated with fasting blood glucose levels (FBG); the patients must be fasting for at least 10-12 hours, then blood glucose levels are measured 2 hours after eating (2hPPG) a meal. In this study, random blood glucose levels (measured at any time of the day without any conditions of fasting and eating) were not performed because the tests could not be completed simultaneously. This examination was administered four times a day: before eating and before bed to be performed independently. It did not describe long-term DM control (blood glucose control for approximately three months). Thus, it could not be used as a reference to see the relationship of stress with a patient's blood sugar levels. The normal range of random blood glucose levels is 80-144 mg/dl. This random blood glucose examination was administered only to overcome problems that arose due to sudden changes in glucose levels (Rachmawati, 2015).

Discussion

Our sample included more males (21 patients, 56.75%) than females (16 patients, 43.24%), different from the findings of Levine (2008), showing that women are more likely to experience endocrine-related diseases, such as diabetes mellitus and gestational diabetes mellitus (GDM) (Levine, 2008). Furthermore, 5-10% of women in productive age are prone to experience Polycystic Ovarian Syndrome (POS). This condition is associated with disrupted insulin secretion, insulin activity, and blood pressure regulation, an early sign of cardiovascular disorders.

T2DM generally occurs in middle-aged people and the elderly. Its prevalence and occurrence are associated

with older age, with about 50% of T2DM patients being over 60 years old (Yakaryılmaz & Öztürk, 2017). In our sample, 34 patients were more than 50 (91.89%), and 3 were less than 50 (8.10%), with an average patient age is 62 years old, consistent with the research conducted by Dunning (2009), explaining that the prevalence of DM increases with age, especially in developing and developed countries ranging from 10-20% at the age of 60-70 years (Dunning, 2009). Ageing may cause a decrease in pancreatic beta-cell function (Kalyani *et al.,* 2010). Pereira et al. (2008) emphasized that age is associated with insulin resistance and obesity in the elderly (Pereira *et al*., 2008).

Table I shows that 97.29% of patients had diabetes for more than six months. In a study conducted by Safitri (2016), 42.8% of patients had diabetes from less than five years (Safitri, 2016). The American Diabetes Association (2009) revealed that 32.6% of respondents had diabetes from 5-10 years (American Diabetes Association, 2009).

Table I: Initial data on the characteristics of the subject

Characteristics		n	Percentage (%)
Gender	Men	21	56.75
	Women	16	43.25
Age	<50 years	3	8.10
	>50 years	34	91.90
The long suffering of diabetes	6 months	1	2.70
	>6 months	36	97.30

The relationship between stressful experiences and controlling blood glucose levels is very different among individuals with T2DM. Stress can affect blood glucose levels directly (by acting on the neuroendocrine system) or indirectly (related to the duration of stress).

The effects of stress on the neuroendocrine system consist of stimulating the nervous system by activating the sympathetic-adrenal-medulla (SAM) followed by hypothalamic-pituitary-adrenal (HPA) activity. During stress, the sympathetic nervous system stimulates the adrenal glands of the medulla to secrete epinephrine and norepinephrine into the blood circulation. The activity of these hormones produces metabolic effects, i.e., increased metabolic rate and blood glucose levels (Lloyd *et al*., 2005; Champaneri *et al*., 2010).

Stress causes the hypothalamus to secrete Corticotrophins Releasing Factor, which releases adrenocorticotropin and stimulates the adrenal cortex to secrete glucocorticoid hormones, such as cortisol, thereby increasing the production of glucose by the liver and reducing its uptake by tissues. Cortisol affects the breakdown of carbohydrates, proteins, and fats through the gluconeogenesis process, which produces glucose as an energy source and plays a significant role in influencing body functions during the resting period (Hasan *et al*., 2014; Cosgorve *et al*., 2012).

The results of this study showed a significant relationship between stress levels and both FBG (p = 0.038 and r = 0.295) and 2hPPG (p = 0.001 and r = 0.508) in T2DM patients at the regional public hospital of West Nusa Tenggara province (Table II). This showed the higher the stress, the higher the FBG and with 2hPPG.

Table II: Linear regression analysis on the effect of stress levels on blood glucose levels

Domain	*r* and *p*-value	
	FBG	2hPPG
Stress level	r = 0.295	r = 0.508
	p = 0.038	p = 0.001

p < 0,05 means there is a significant effect.

The results are consistent with those of Lustman and the authors (2005), showing a relationship between stress, low self-care, and hyperglycemia (p=0.05) and between stress and increased haemoglobin glycosylate (HbA1c) after controlling for body weight (Lustman *et al*., 2005). Stress in T2DM patients may cause biochemical changes, such as hyperglycemia and the hypothalamus-pituitary-adrenal pathway activity (HPA-axis) (Llorente & Malphurs, 2007).

In 2008, Szoke reported a significant relationship between stress and diabetes, especially in women aged 20-39 years and men, showing more stress at a young age (Szoke *et al*., 2008). This difference could be due to differences in individual responses to stress and its description as measured by the PSS.

Furthermore, the correlation between stress and FBG and 2hPPG was positive, where the higher the stress, the higher the values. Also, the FBG correlation value was lower than that of 2hPPG.

When the study was conducted, measuring 2hPPG was a factor that had a considerable effect on stress. Indeed, waiting in a queue, tiredness from standing because of the limited number of chairs, and the unsatisfactory service at the hospital, made patients irritable and emotional and resulted in increased stress.

Conclusion

This study showed that higher stress significantly increases fasting blood glucose (FBG) and 2-hours postprandial glucose (2hPPG) levels.

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